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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/826,419	04/05/2001	Thomas H. Osterheld	003415	5039

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APPLIED MATERIALS, INC.
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EXAMINER
THOMAS, DAVID B

ART UNIT	PAPER NUMBER
3723	

DATE MAILED: 10/25/2002

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)	
	09/826,419	OSTERHELD, THOMAS H.	
	Examiner	Art Unit	
	David B. Thomas	3723	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *25 September 2002* .

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *5-13 and 21-25* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *5-13 and 21-25* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

11)☐ The proposed drawing correction filed on _____ is: a)☐ approved b)☐ disapproved by the Examiner.

If approved, corrected drawings are required in reply to this Office action.

12)☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

13)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____ .

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

14)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).

a) ☐ The translation of the foreign language provisional application has been received.

15)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☒ Information Disclosure Statement(s) (PTO-1449) Paper No(s) *13* .
4) ☐ Interview Summary (PTO-413) Paper No(s). _____ .
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: .

DETAILED ACTION

Continued Examination Under 37 CFR 1.114

1. A request for continued examination under 37 CFR 1.114, including the fee set forth in 37 CFR 1.17(e), was filed in this application after final rejection. Since this application is eligible for continued examination under 37 CFR 1.114, and the fee set forth in 37 CFR 1.17(e) has been timely paid, the finality of the previous Office action has been withdrawn pursuant to 37 CFR 1.114. Applicant's submission filed on September 25, 2002 has been entered.

Claim Rejections - 35 USC § 103

2. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

3. Claims 5-13 and 21-25 are rejected under 35 U.S.C. 103(a) as being unpatentable over Tzeng (5,934,974) in view of Raeder et al. (6,331,137).

Tzeng ('974) discloses an in-situ sensor measures polishing pads during chemical mechanical polishing. From the measurements, polishing pads can be identified as worn out or unevenly worn and replaced. Scheduling maintenance according to current measurements, rather than according to statistical predictions, minimizes down time for maintenance and still prevents use of worn out or unevenly worn polishing pads. Alternatively, a tool is reconfigured according to the polishing pad measurements. Reconfiguring the tool can prolong pad life and improve polishing

performance. One embodiment of the invention includes a non-contact sensor such as a laser sensor that directs an incident beam at a target area and determines a distance to a reflection point by triangulation of incident and reflected beams. As polishing pads wear, distances to the reflection points increase (see Abstract). During polishing, an analyzer or system controller in the CMP system determines from the in-situ sensor measurements whether polishing pads are worn out or unevenly worn and signals the systems user when pad maintenance is required. Polishing is only interrupted for maintenance when the CMP system requires pad replacement. Thus, down time for polishing pad maintenance is minimized. Additionally based on the measurements of the pads, the system controller can adjust operating parameters of the CMP system, as required to improve system performance or cause the pads to wear more evenly (Col. 1, lines 48-58). Distances are measured to points in depressions and points on lands of the polishing pads as the depressions or lands move into the sensor's target area. As polishing pads wear, distances to the reflection points on lands increase, but distances to bottoms of depressions remain approximately constant. The difference between an average distance to points on a land and an average distance to points in a depression indicates the thickness of the land. A root means square variation of the distances to a land indicates the variation in the land thickness, i.e., the surface roughness (Col. 1, line 67 and Col. 2, line 1-9). A controller 180 controls a drive system 120, which moves sensor 110 and processes measurements from sensor 110 during CMP operations. Controller 180 identifies uneven or excessive wear of the polishing pads from the acquired measurements of the polishing pads. If uneven wear is detected, controller

180 can change the operating parameters of CMP tool 100 in an attempt to compensate. For example, the range of motion of wafer head 160 can be altered to increase the time during which the wafer remains in areas where pad wear is less. A portion of the pad that wears more slowly may indicate that pressure on that portion of the pad is too low, and controller 180 could adjust the configuration of support 150 or wafer head 160 to increase pressure in selected areas (Col. 3, lines 55-67 and Col. 4, lines 1-6). In the exemplary embodiment, drive system 120 moves sensor 110 across the width of belt 130 perpendicular to direction of motion of belt 130. Alternatively, *sensor 110 can move along any desired path*. For example, sensor 110 can move an angle with the direction of motion of belt 130 so that the motion of sensor 110 relative to belt 130 causes sensor 110 to cross the width of belt 130 and measure a polishing pad's profile perpendicular to the direction of motion. Generally, the distance measurements correspond to portions of the polishing pads that are along a path 170 that depends on the movement of sensor 110 and belt 130. Belt 130 can be stopped at any location to allow measurement of a specific portion of the polishing pads (col. 4, lines 35-47). The determination of pad thickness is performed by measuring the difference between a point in depression in a polishing pad and a point on a land portion of the polishing pad. Depressions in a polishing pad can take many forms including a groove or hole or perforation through the polishing pad. FIG. 3 illustrates the relation between distance measurements and points on a pad 310. Pad 310 includes depressions 314 that are separated by high areas (lands 312). Pads are typically replaced when the lands wear to a predetermined thickness or when accumulated wear

has made the surface of the pad too uneven for the desired polishing precision. Sensor 110 while moving across the width of a polishing pad measures distances to a series of about 5 to 10 points in each depression encountered and a larger series of points on each land of the polishing pad. A controller when processing measurements from sensor 110 can identify a transition from a depression to a land or from a land to a depression by an abrupt change in the distance measurements. For example, FIG. 3 shows an abrupt decrease in distance measurement at a transition from a series of measurements 324 corresponding to a depression 314 to a series of measurements 322 corresponding to land 312. Measurements 324 can be averaged for the depression. Such averages statistically provide a more accurate indication of the distance to depression 314 than would a single measurement (Col. 5, lines 40-67). Although Tzeng ('974) focuses on a continuous loop polishing belt, Tzeng suggests that the invention could be applied to a turntable pad (Col. 6, lines 56-58 and Col. 7, lines 45-50). Tzeng ('974) discloses the claimed invention except for focusing upon a belt polisher rather than a table-type round polishing pad, although Tzeng ('974) has clearly suggested such. Raeder et al. ('137) discloses a polishing pad having a cross-sectional open area which varies with depth from the pad surface. The cross-sectional open area of the pad may increase and/or decrease moving away from the outer pad surface. In some cases, the cross-sectional open area of the pad varies uniformly with depth over the entire pad. In other cases, certain regions of the pad may define local cross-sectional open areas which vary differently. This can, for example, allow the open area of the pad to vary with pad life and improve or tailor the polishing uniformity of the pad

and/or extend the useful life of the pad (see Abstract). The pad 300 generally includes openings, discussed in detail below, which define the cross-section open area of the pad 300. The openings may be disposed over the entire pad 300 or may be provided only in the outer area 304. The openings may take any of a number of different shapes. For instance, the openings may be grooves, circular openings, or openings of non-circular shape. The openings may also be formed in a pad in a number of different manners. For instance, the pad may be molded, stamped, punched or grooved with a desired configuration of openings. The characteristics, such as the arrangement and/or dimensions, of the openings typically vary with the depth of the pad to provide cross-sectional open areas which vary with depth (Col. 3, lines 50-67. FIG. 6 illustrates a partial, vertical cross-sectional of a pad 600 having a cross-sectional open area which increases with depth from the outer pad surface 602. The example *pad 600 includes openings* 602a-c which extend *from the base* 608 of the pad 600 into the pad body 610 by different amounts (Col. 4, lines 32-36). Raeder et al. ('137) further discloses that the cross-sectional open area of a pad may vary with depth differently in different regions of the pad. FIG. 13, for example, is a top view of a polishing pad 1300 having a cross-sectional open area which *varies with radius* as well as with depth (Col. 5, lines 26-30). Since the surface area of the pad of Raeder et al. ('137) changes with the wear of the pad thickness, i.e. the surface area increases in the embodiment illustrated in Figure 20; the pattern of Raeder et al. ('137) inherently provides a means of indicating the wear of the pad. Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to have modified the in-situ monitoring system of Tzeng

('974) by providing a round polishing pad having a predetermined pattern of reliefs in a main polishing surface of the pad, such as the pad of Raeder et al., wherein, as the application of the in-situ monitoring system to a round polishing pad has been clearly suggested by Tzeng ('974), and in the application wherein the pad is round, as the sensor for measuring the distance from the main polishing surface to a bottom surface of each of a plurality of reliefs moves across the pad, in any desired path (Col. 4, lines 37-43), the sensor would inherently measure a pad wear profile based upon a function of the pad radius since a pad such as that of Raeder et al. ('137) is round and thus, by definition, the reliefs would be distributed across the pad surface as a function of radius.

Response to Arguments

4. Applicant's arguments filed September 25, 2002 have been fully considered but they are not persuasive. The examiner respectfully contends that Tzeng ('974) does indeed disclose a polishing belt with voids in the surface; that Tzeng clearly suggests the implementation of pad wear measurement of a round or turntable polishing pad; that although Tzeng ('974) relies upon triangulation of a reflected laser beam in order to calculate the measurement, Tzeng still measures the distance from the main surface of the polishing pad to a bottom surface of each of the reliefs by calculating the difference; and that although, as argued by the applicant, Tzeng discloses in one embodiment that the sensor retraces the same wear path, Tzeng has not limited himself[sic] to retracing the path and clearly suggests that the sensor can move along any desired path (see the examiner's arguments presented above in the rejection of claims 5-13 and 21-25).

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to David B. Thomas whose telephone number is (703) 308-4250. The examiner can normally be reached on 8:00-6:30 M-TH.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Joseph J. Hail can be reached on (703) 308-2687. The fax phone numbers for the organization where this application or proceeding is assigned are (703) 872-9302 for regular communications and (703) 872-9303 for After Final communications.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is (703) 308-1148.

Joseph J. Hail, III
Supervisory Patent Examiner
Technology Center 3700

dbt
October 21, 2002